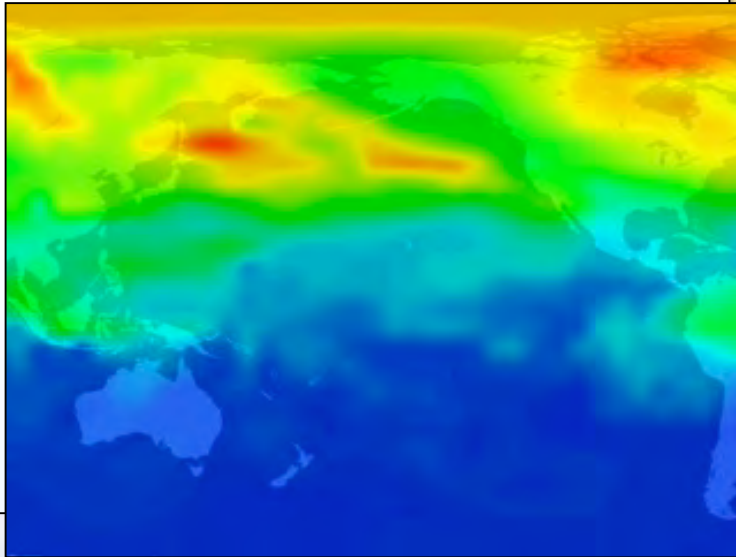




Measurement of GHG Emissions from Dairy Farm

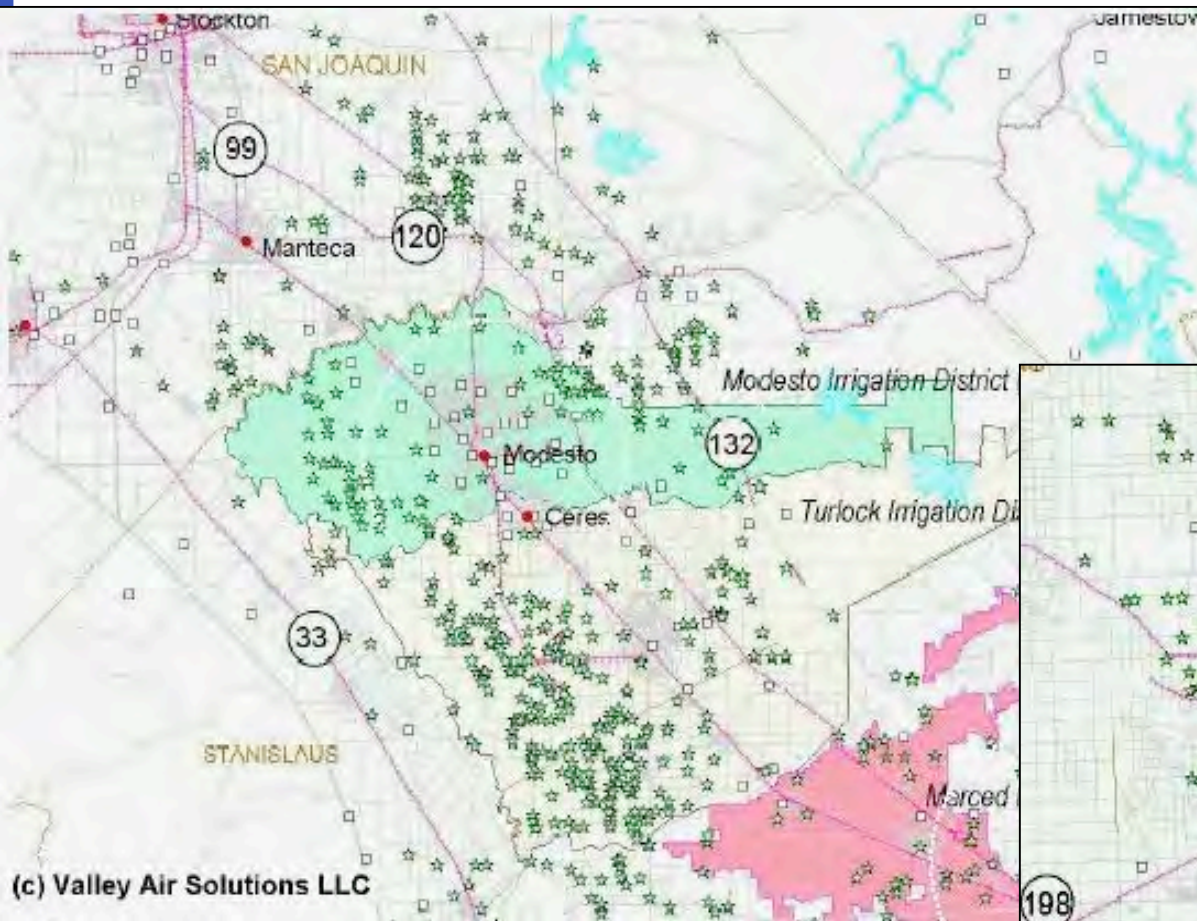
Climate Change Research Conference
Sacramento, Sept 13, 2009



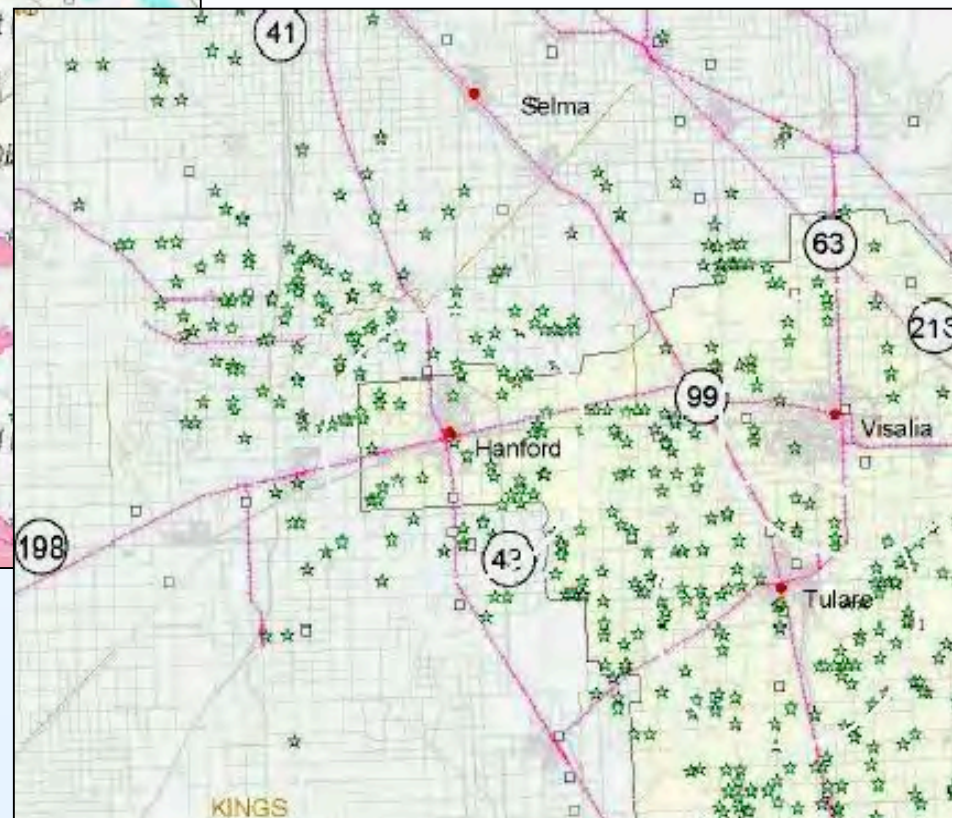
Frank Mitloehner, PhD
Air Quality CE Specialist
Animal Science, UC Davis

Dairy Locations

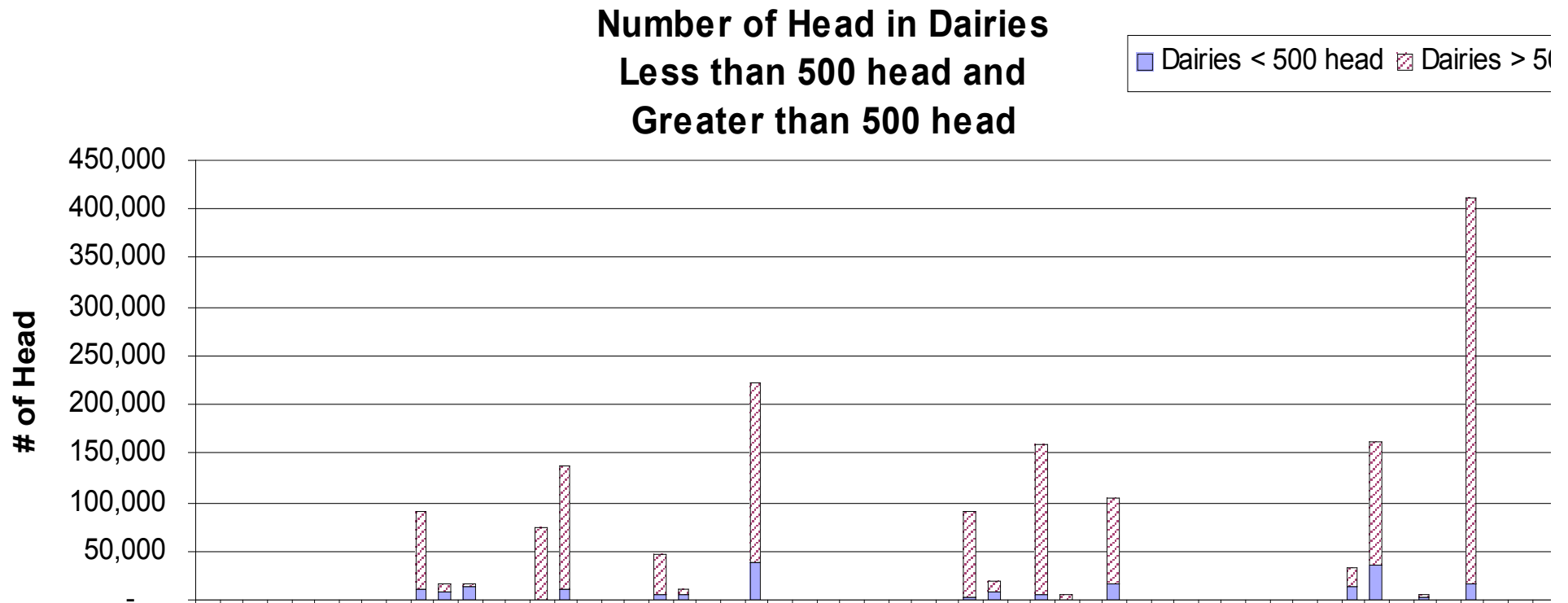
North



South



Number of Cows vs Dairy Size



Global Warming Potential (GWP) of Main GHG

- Carbon Dioxide, CO₂ 1
- Methane, CH₄ 21
- Nitrous Oxide, N₂O 310



Funding & Collaborators

CEC-PIER, EPA IX, CARB, SWRCB,
and SJVAPCD

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Objective

- To simulate dairy freestall and drylot housing conditions by using UCD concrete floored chambers and dirt floored “bubble” enclosures
- To measure GHG and speciated VOCs using different methods and instruments for dry and lactating cow and waste emission measurements
- To supply basic data to be used for a process based model that predicts GHG emissions from California dairies

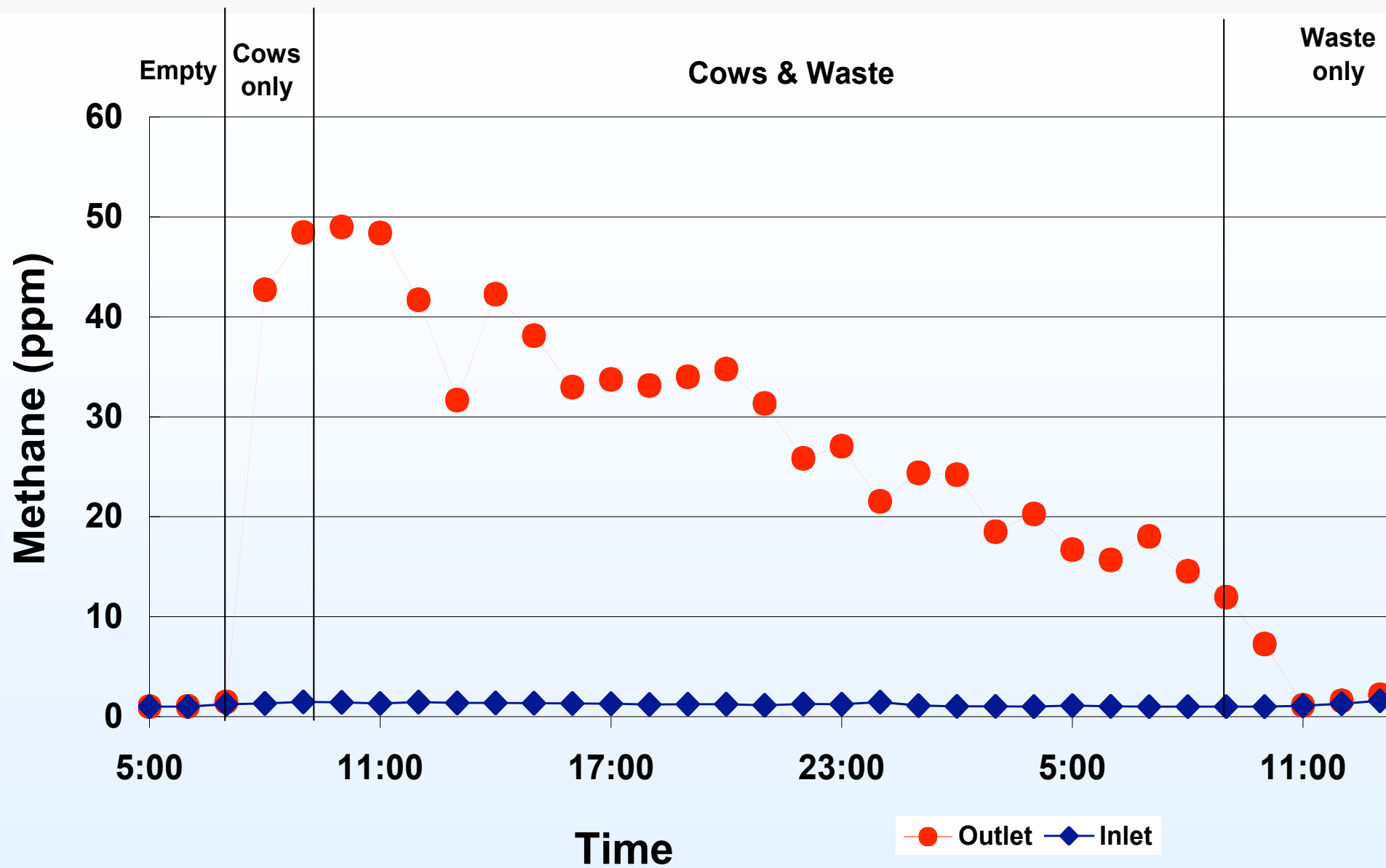
Materials and Methods

- Close-up dry cows
- Far-off dry cows
- Low producing lactating cows
- Medium producing lactating cows
- High producing lactating cows

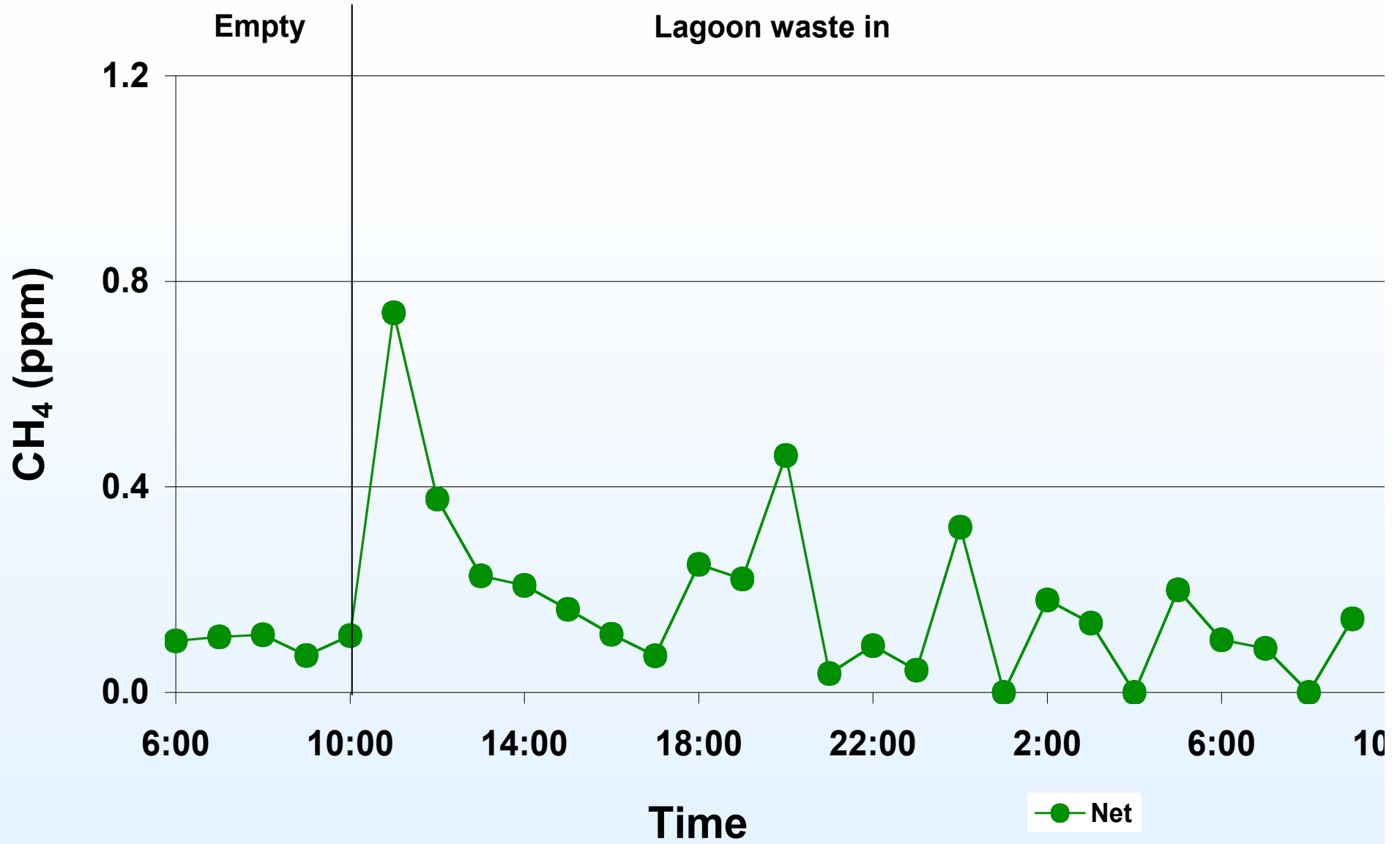




Dry Cows

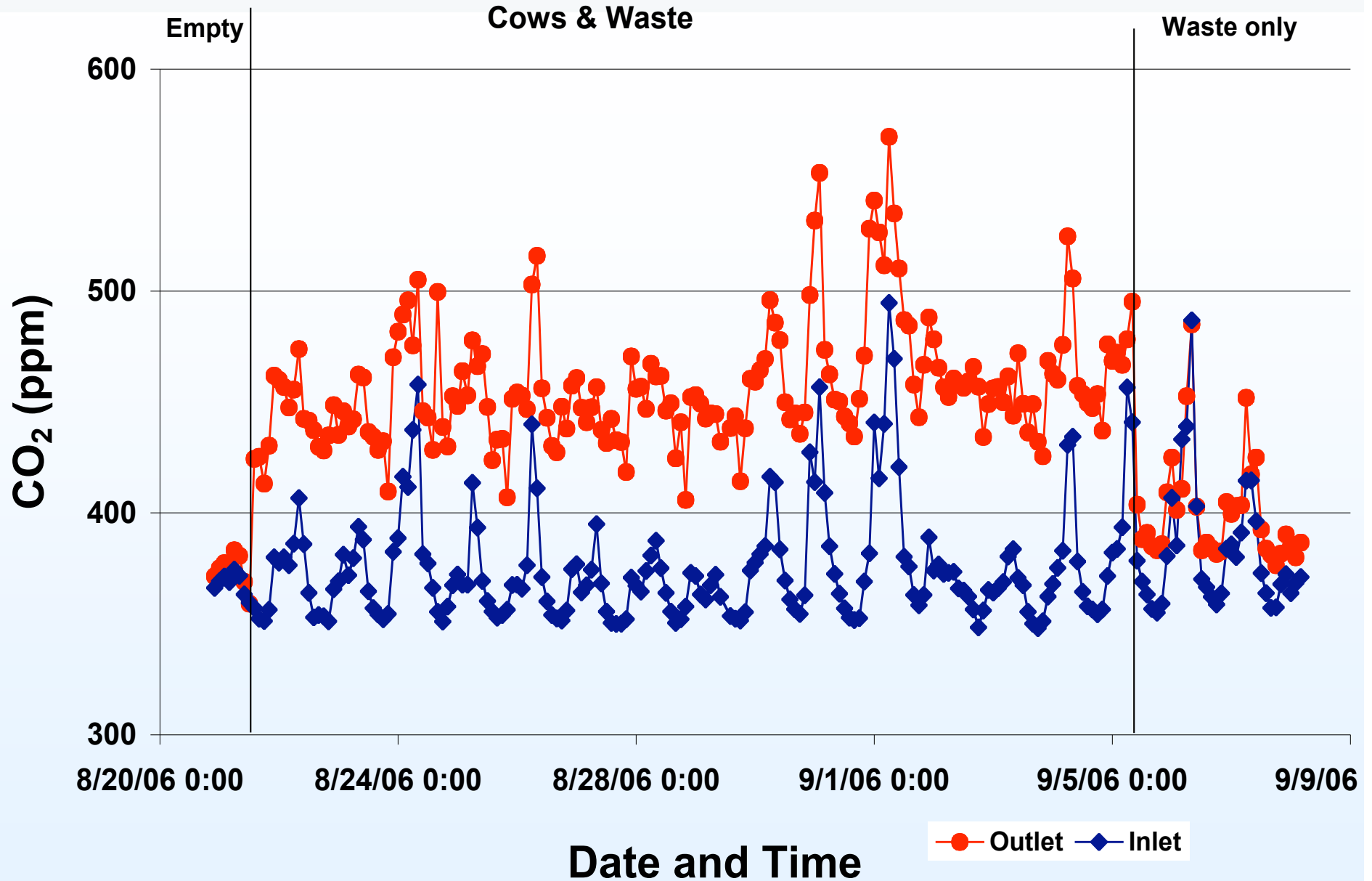


Lagoon waste

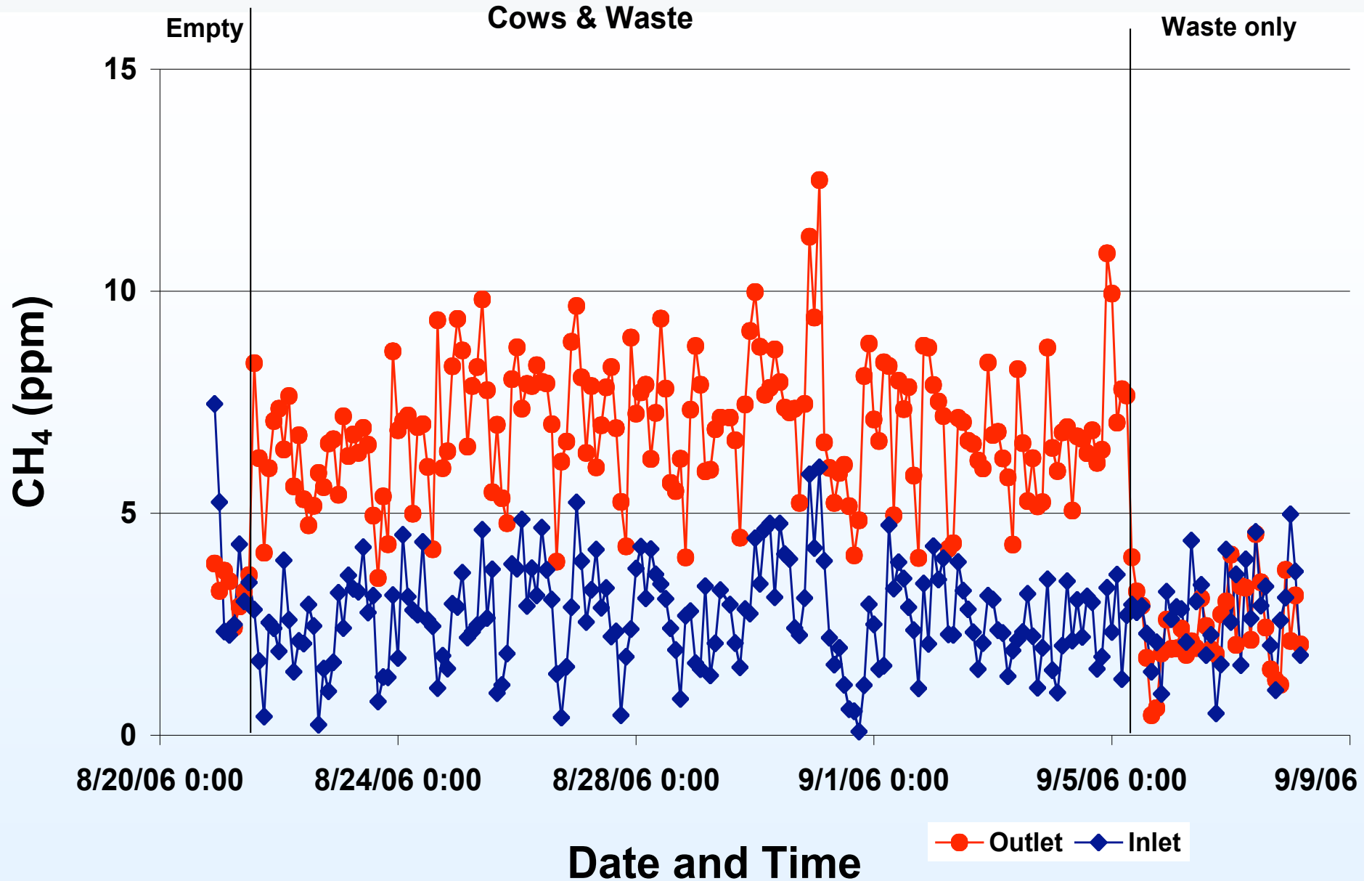




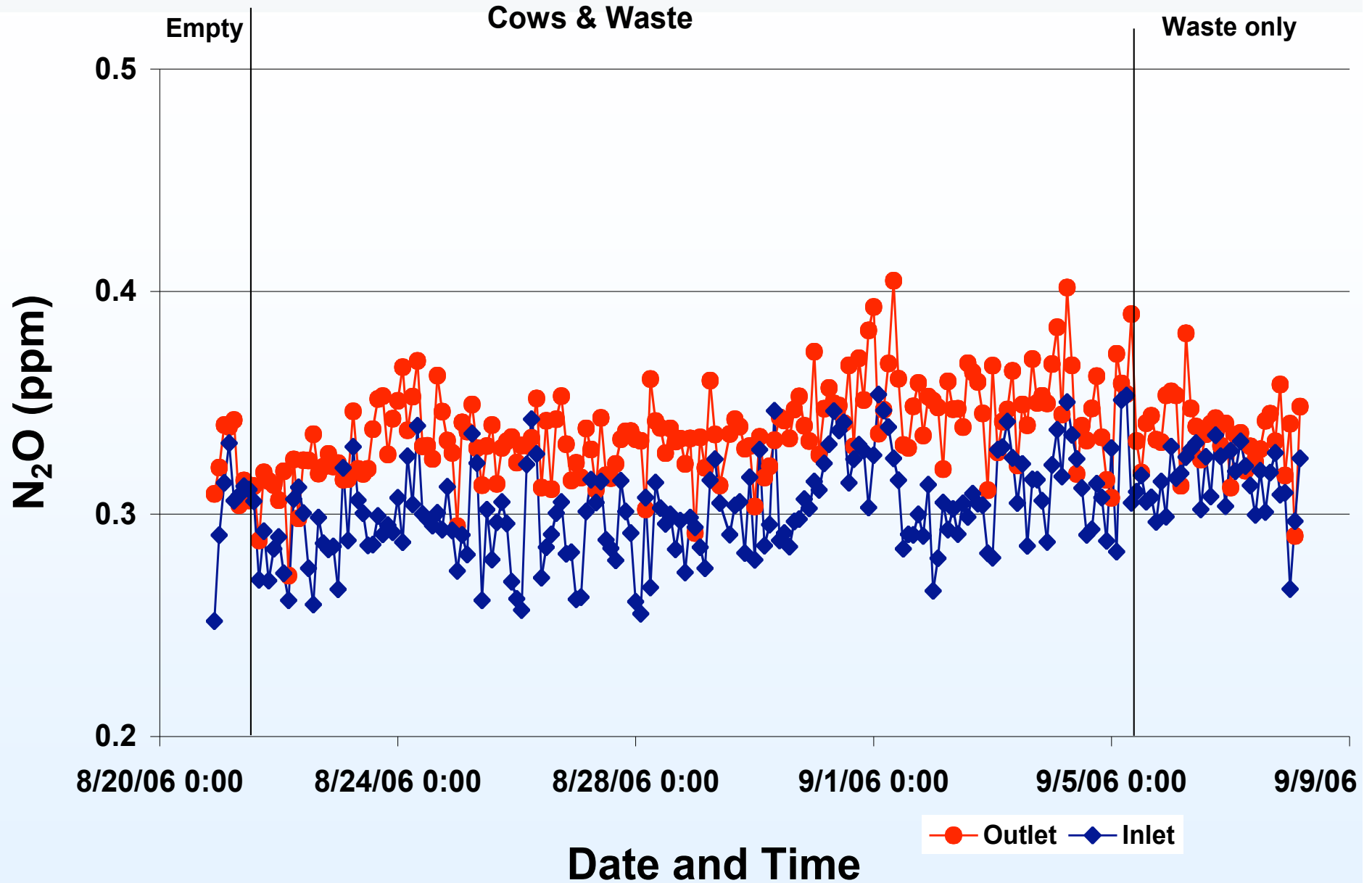
Concentration from dry cows group and waste, bubble exp.



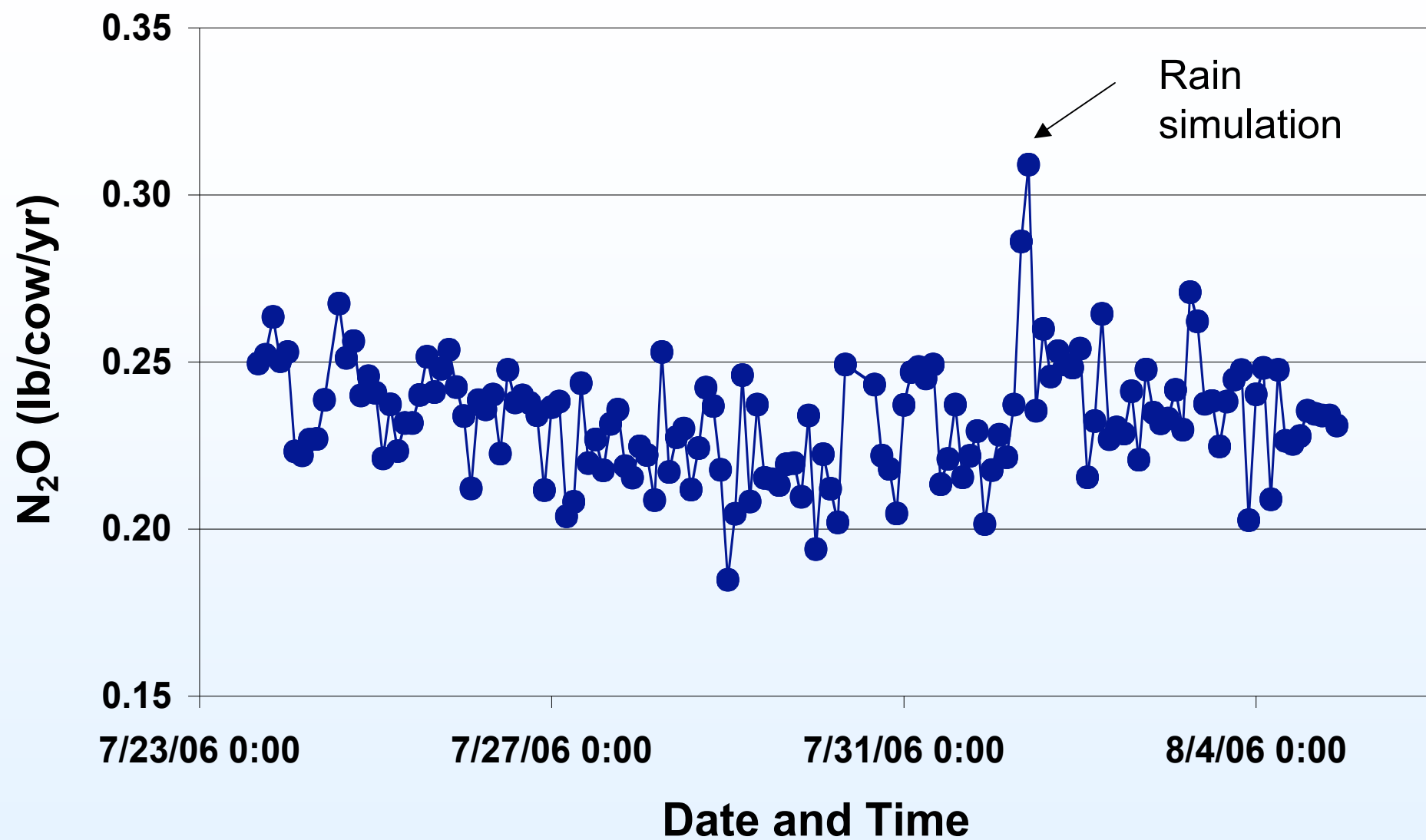
Concentration from dry cows group and waste, bubble exp.



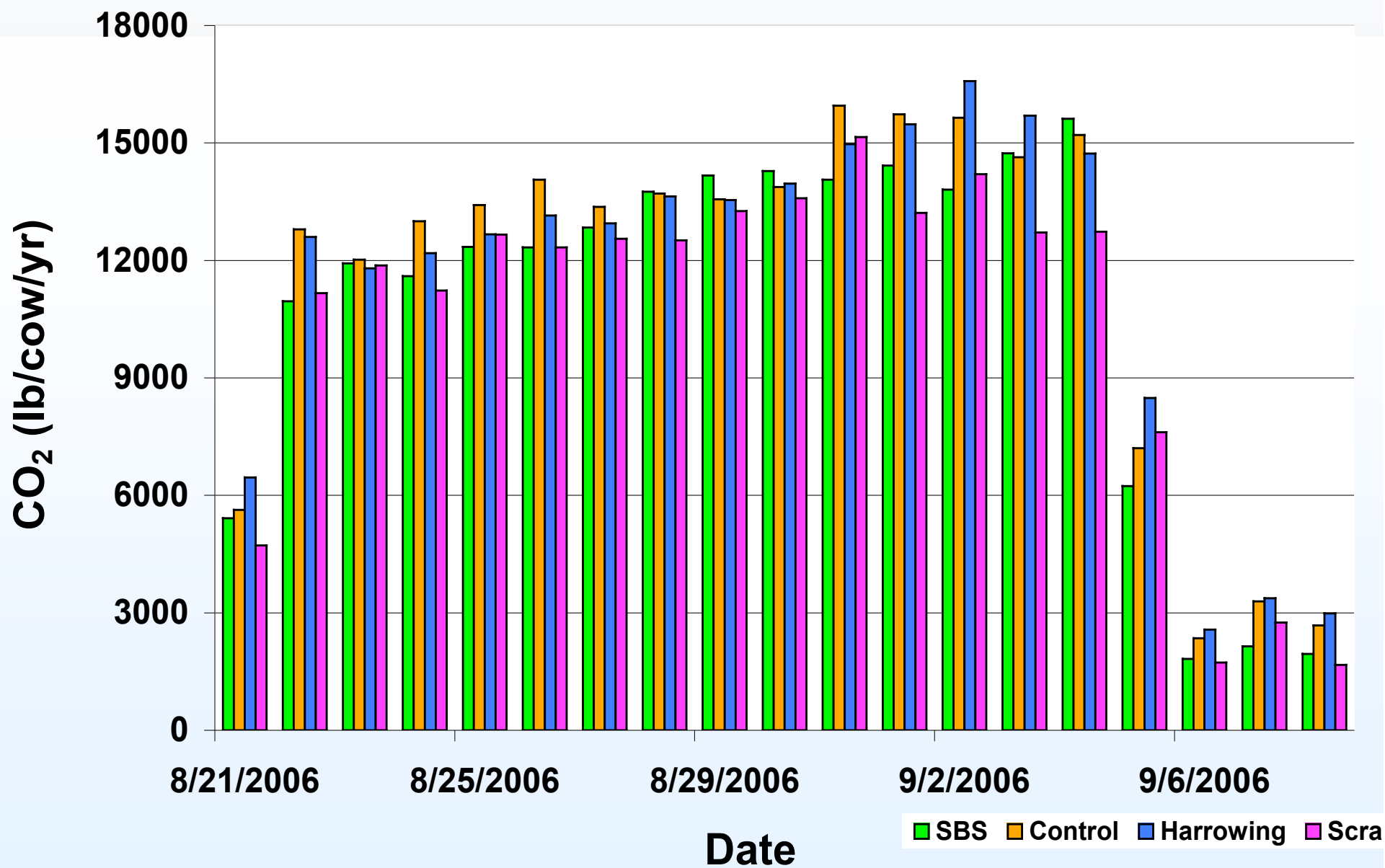
Concentration from dry cows group and waste, bubble exp.



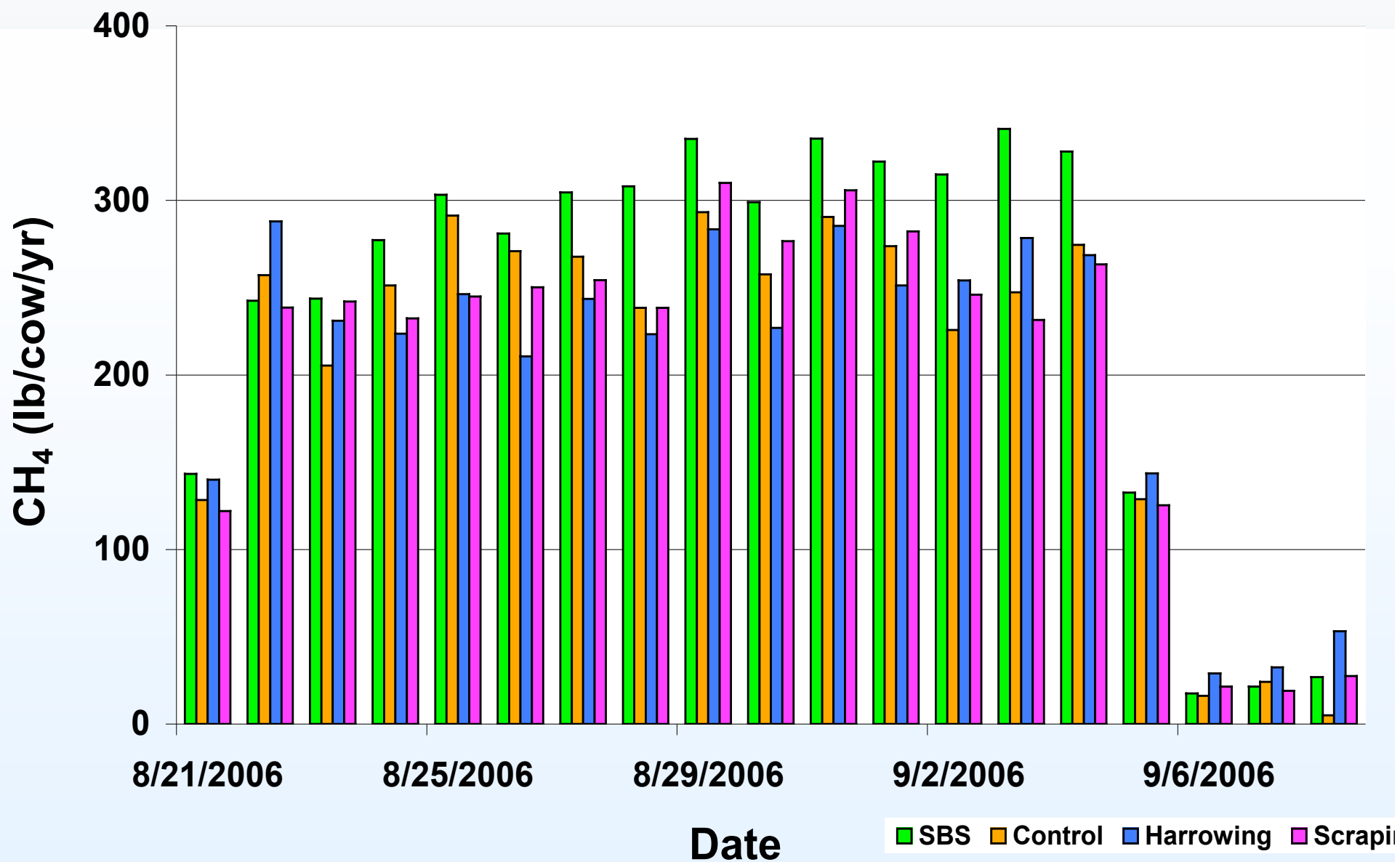
Emissions from dry cows and waste



Emissions from dry cows and waste



Emissions from dry cows and waste



Avg Emissions per Cow (lb/cow/yr)

	CO₂	CH₄	N₂O
Dry cows	13,637	268	6.9
Lact cows	18,325	412	8.7

GWP (Tg CO₂ equivalents) of Dairy Cow in SJV

	CO ₂	CH ₄	N ₂ O	Total
Dry cows (1.7 mio)	10.5	4.3	1.6	16.5
Lact. Cows (1.7 mio)	14.1	6.7	2.1	22.9
<i>Total SJV (3.4 mio)</i>	24.6	11.0	3.7	39.4

Tg = terragram = 1 million metric ton

SJV dairy versus US sources

- SJV dairy GHG = approx 39.4 Tg
- US enteric fermentation (CH_4) = 112 Tg
- US human sewage = 16 Tg
- US cement manufacture = 46 Tg
- US steel production = 51 Tg
- US fossil fuel combustion = 5,600 Tg

Conclusions

- Dairies are a significant GHG source
- Main dairy GHG source are cows rather than waste (i.e. enteric fermentation and respiration)
- CO₂ versus CH₄ from dairies has more than twice the GWP
- N₂O dairy emissions are comparatively unimportant
- CO₂ emissions from cow respiration cannot be mitigated w/o reducing herd size
- CH₄ emissions from enteric fermentation can be reduced through improvements of feed efficiency and adjustments of feeding strategies

